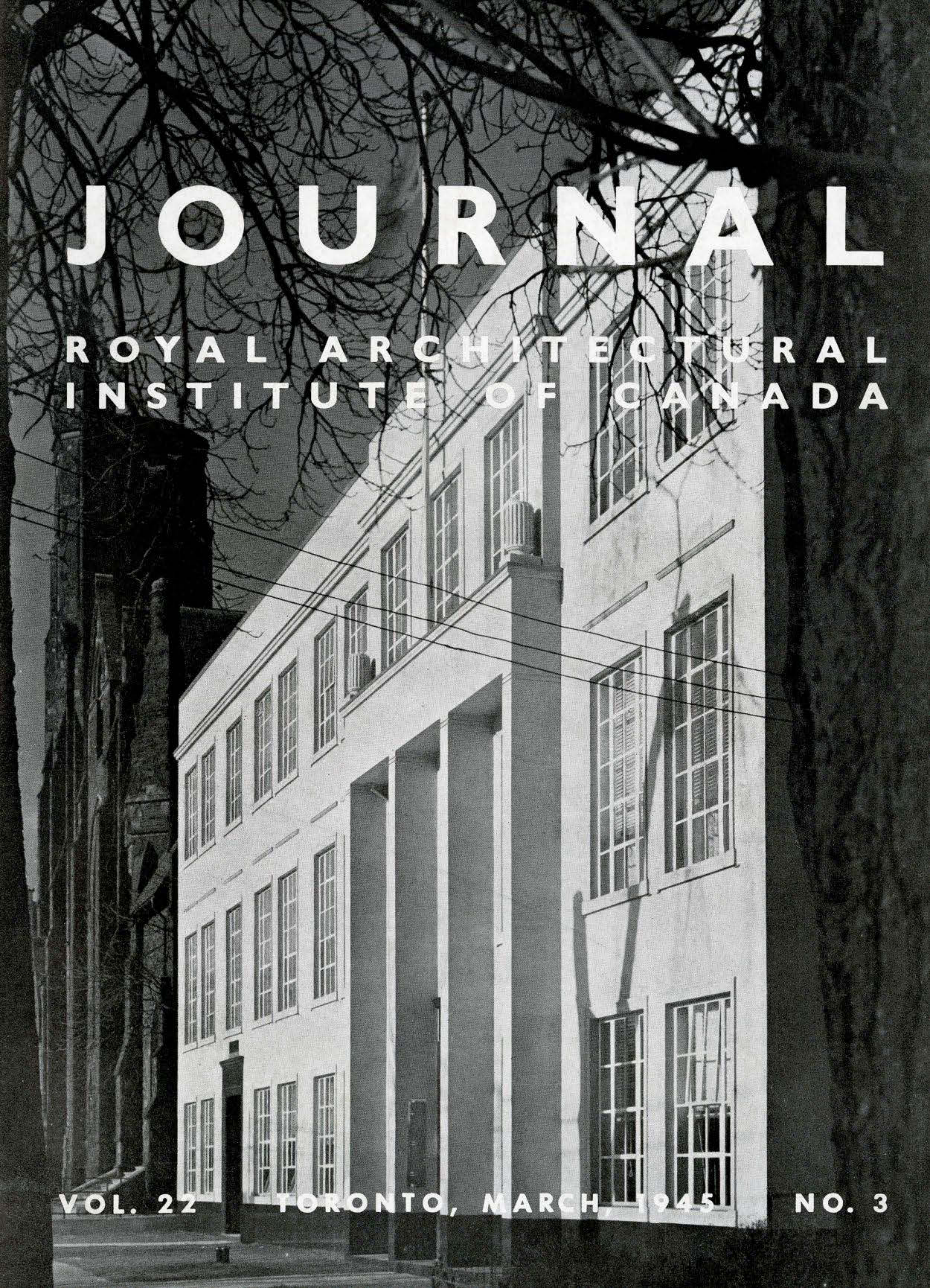
JOURNAL

ROYAL ARCHITECTURAL INSTITUTE OF CANADA



VOL. 22 TORONTO, MARCH, 1945 NO. 3

JOURNAL

ROYAL ARCHITECTURAL INSTITUTE OF CANADA

Serial No. 235 TORONTO, MARCH, 1945 Vol. No. 22, No. 3

CONTENTS

Editorial 42
The Thirty-Eighth Annual Meeting of the R. A. I. C. 43
The Prefabricated House Industry, by E. G. Faludi and Catherine Chard . . . 56
Provincial Page 63

PLATES

Ingram and Bell Limited, Toronto, Ontario 51
The Ontario Services Club, Lower Regent Street, London, England 54

THE INSTITUTE DOES NOT HOLD ITSELF RESPONSIBLE FOR THE OPINIONS EXPRESSED BY CONTRIBUTORS

OFFICERS

President .... FORSEY PAGE (F)
First Vice-President .... MILTON S. OSBORNE (F)
Second Vice-President .... ROBERT MORTON
Honorary Secretary .... J. ROXBURGH SMITH (F)
Honorary Treasurer .... CHARLES DAVID (F)
Secretary .... CONSTANCE GRIFFITH, 74 King Street East, Toronto 1, Ontario

COUNCIL

JOHN MARTLAND
PETER L. RULE
Alberta Association of Architects

G. NORRIS EVANS
WILLIAM FREDK. GARDINER
JOS. F. WATSON
Architectural Institute of British Columbia

ROBT. E. MOORE
E. FITZ MUNN
MILTON S. OSBORNE (F)
Manitoba Association of Architects

J. K. GILLIES
H. CLAIRE MOTT (F)
Architects Association of New Brunswick

LESLIE R. FAIRN (F)
ROBERT MORTON
Nova Scotia Association of Architects

L. GORDON BRIDGMAN
MURRAY BROWN (F)
A. J. HAZELGROVE (F)
A. S. MATHERS (F)
R. SCHOFIELD MORRIS (F)
FORSEY PAGE (F)
W. B. RIDDELL (F)
BRUCE H. WRIGHT (F)
Ontario Association of Architects

O. BEAULE
CHARLES DAVID (F)
EUGENE LAROSE
HAROLD LAWSON (F)
MAURICE PAYETTE
GORDON McL. PITTS (F)
J. ROXBURGH SMITH (F)
Province of Quebec Association of Architects

E. J. GILBERT
W. G. VanEGMOND
Saskatchewan Association of Architects

EDITORIAL BOARD

FORSEY PAGE (F), Chairman

GORDON S. ADAMSON, Toronto
HARRY BARRATT, Vancouver
O. BEAULE, Quebec
JOHN BLAND, Montreal
S. BRASSARD, Quebec
F. BRUCE BROWN, Toronto
MURRAY BROWN (F), Toronto
CECIL S. BURGESS (F), Edmonton
RAYMOND W. G. CARD, Toronto
ALFRED CHAPMAN (F), Toronto
ROBT. F. DUKE, Saskatoon
GLADSTONE EVANS, Toronto
LESLIE R. FAIRN (F), Wolfville
GORDON FOWLER, Toronto
HAROLD LAWSON (F), Montreal
A. S. MATHERS (F), Toronto
HARRY D. MARTIN, Toronto
EARLE C. MORGAN, Toronto
H. CLAIRE MOTT (F), Saint John
MILTON S. OSBORNE (F), Winnipeg
MARCEL PARIZEAU, Montreal
JOHN B. PARKIN, Toronto
JOHN S. PORTER, Vancouver
J. ROXBURGH SMITH (F), Montreal
EMILE VENNE, Montreal
ROBT. M. WILKINSON, Toronto
BRUCE H. WRIGHT (F), Toronto

ERIC R. ARTHUR, EDITOR

Editorial and Advertising Offices - - - - - - 57 Queen Street West, Toronto 1

J. F. SULLIVAN, PUBLISHER

SUBSCRIPTION RATES

Canada and Newfoundland—Three Dollars per year. Great Britain, British Possessions, United States and Mexico—Five Dollars per year. All Other Countries—Six Dollars per year. Single Copies—Canada 50 Cents; Other Countries 75 Cents.

THE PREFABRICATED HOUSE INDUSTRY

By **E. G. FALUDI** and **CATHERINE CHARD**

INTRODUCTION—GENERAL PICTURE

In both the United States and England there are now large organizations producing or preparing to produce either—

(a) Sections of buildings that can be assembled into a standardized house or,

(b) Building units that permit the assembly of houses without limitations as to size or plan.

These house parts are being produced from a variety of materials such as, solid timber, plywood, fibreboards, sheet metal, concrete slabs. A new British plan for post-war production of prefabricated houses has approached the problem through the channel of firms representing five major British industries, *i.e.* aircraft plywood, steel tubing, light alloys, iron and steel. This interest in prefabrication of houses has grown out of the urgent need of aiding war production by housing factory workers and out of the acute overall housing shortage. In Great Britain the latter is simply the result of destruction due to the air war, while in the United States and Canada it is due to the slack building period which occurred during the pre-war depression.

In Great Britain the prefabricated house industry is new and developing, being forced to deal with an emergency situation. In the United States and Canada it is at present in a stagnant position because industry is not at the moment pressing the demand for additional housing for its workers. It is a fact that the American and Canadian prefabrication factories are decreasing their output or have stopped production completely. The main reason is that the government authorities are not issuing new orders for defence production as in the first three years of the war. At the same time, no building materials are available for large scale production for the private housing market.

This does not mean, however, that those industries have given up this business for the future. On the contrary, they are preparing with great interest schemes and products aimed at the capture of the post-war market when a special demand will call for houses of all possible types.

Disorganization of Residential Construction Industry

These firms are attracted to housing because of the existence of a wide market and because of the fact that the building industry in the housing field is totally unorganized. All the major processes of residential construction remain the same as they were when labour cost was lower than it is today. Convincing proof of this is offered by the fact that the average man-hour productivity in American industry increased 60 per cent. in the first thirty years of this century. Some of the increases due to the introduction of machine methods were as great as 300 per cent. The residential construction industry, however, showed no gain at all. In fact, it is frequently asserted that the man-hour productivity actually declined. A house is still a hand-made product produced by an increasingly complex group of specialists. These specialists—carpenters, masons, electricians and so on—frequently represent sub-contracts that are loosely co-ordinated by a person acting as a general contractor. Each group deals on a level of retail trade. Each group has its own overhead in office maintenance, advertising, cost estimating and contingencies. Each group deals with a separate group of material supply houses. Each material supply house has its own overhead.

Individual builders are thus caught in a web of complex relationships with manufacturers, dealers, labourers and buyers. Instead of the integration which would make for cheaper houses and more steady employment, there is a lack of standardization, with attendant localization of operations and backwardness in technology. This is the situation which the prefabricator attacks with the weapon of efficiency methods.

An understanding of the subject requires the review of:

A. The Post-War Housing Market in Canada.

B. The Production Capacity of the Canadian Building Industry.

C. Prefabricated House Production in Britain, the United States and Canada.

A. POST-WAR CANADIAN HOUSING MARKET

Machine power and man power notwithstanding, an industry is no bigger than its market. Hence, it is essential to look at the housing market before venturing to discuss any attack upon the field.

Curtis Report

The most significant statement to be made on Canadian housing needs is that given by the Curtis Report (the final report of the sub-committee on Housing and Community Planning, under the Advisory Committee on Reconstruction), March 24th, 1944. On page 151 of this Report, following a discussion of the matter in considerable detail, the Committee gives a table showing the needs of a Canadian Housing Programme for the first ten years of such an effort. The Committee states that in the first ten years of an effective minimum housing programme, we should provide for 606,000 urban, non-farm homes and, in addition, should provide for 94,000 homes in farm areas, or a total of 700,000.

Adamson

A second official reference is contained in a statement made by A. R. Adamson, Member for York West, in the House of Commons, February 18th, 1943. (Hansard, Vol. LXXXI, No. 16, p. 545): "It has been further estimated in Washington, officially, by Frederick M. Babcock, that Canada must build in the ten-year period subsequent to the war between 750,000 and a million houses, in order to maintain a reasonable standard of living".

Dominion Bureau of Statistics

The Dominion Bureau of Statistics gives an idea of the scale of the problem by the following comparison:

In Canada in 27 cities of over 30,000 population, there were 150,000 crowded households (less than one room per person) in June, 1941. To give a separate home to each family in these 27 cities would require housing accommodation equivalent to that of Ottawa, Hamilton, London and Calgary combined.

House Building in Pre-War Period

The sagging of the building curve in Canada in the pre-war period was indisputably due to the Business Depression. Even under the policy of encouraging building and house renovation pursued by the Federal Government through the agency of the National Housing Act, only 2.8 houses per 100 families were built in Canada between the years 1930 and 1937, whereas in England and Sweden in the same period the number of houses built by unassisted private enterprise alone was 16.5 and 26.3 per hundred families respectively.

In view of such facts it is very evident that the building industry will be called upon to carry responsibility for large-scale employment. Housing is looked to by economists as a backbone industry in the structure of the post-war Canadian pattern.

B. PRODUCTION CAPACITY OF THE CANADIAN BUILDING INDUSTRY

Workers Required by Building Industry for Proposed Housing Programme

The problems of the Canadian building industry are in the order of their importance, labour, transportation and materials. And of these, the most critical, by far, is the labour factor. Consider the following figures extracted from "The Labour Value of the Building Dollar", (by O. J. Firestone, October, 1943), a publication of the Housing Administration, Department of Finance, Ottawa. An analysis based on the construction of more than 25,000 housing units, shows that each dwelling provided, on the average, about 2,300 man-hours of on-site and about 3,000 man-hours of off-site employment, or a total of 5,300 man-hours in all. With this average as a basis, a 50,000 unit programme (a very minimum consideration in view of the 70,000 housing units per year per 10 years recommended by the Curtis Report) would provide 265 million man-hours; or, if the average working year is taken to consist of 2,000 man-hours, employment for 133,000 men.

Workers Available in Building Trades

But how many workers trained in the building trade are available in Canada? In eight years, from 1935 to 1943, the total residential construction undertaken under the National Housing Act provided employment for only about 8,250 men per year on an average. If we assume that the total residential construction in Canada was even as high as ten times that built under the N.H.A., still the number of workers employed on house building during those pre-war years was only about 82,500 at a maximum.

The post-war housing programme needs, we have seen, at least 133,000 workers and the maximum number we can expect to draw on is 82,500. Hence, we have a deficiency of at least 51,000 workers in the building industry.

Curtis Report. Training of Workers in Building Trade

But the gravity of the situation is much more pressing as evidenced by the Report of the Curtis Committee which states on page 155: "According to the National Registration of 1940, about 37 per cent. of all skilled construction workers are over 50 years of age, the proportion being considerably higher for some occupational groups, *e.g.*, bricklayers. Apprenticeship training was only on a small scale before the war, and little has been done since, so that the aging process of construction craftsmen is continuing."

Some experts, on the other hand, assume that the capacity of the building industry will be raised by the conversion of skilled labour from war industries. It is true that the aircraft and ship building industries have provided opportunities for training a large amount of unskilled labour in the working of wood and plywood products. But, whatever this training has produced it is factory work, aided greatly by machines and the advantages of mass production organization. It is dangerous, therefore, because of these considerations, to assume that such war-trained labour will be able to contribute very much to the conventional building trade with its outdoor weather conditions and lack of production technique.

Shortage of Skilled Building Craftsmen

However, even if we assume that the war industries have trained a number of carpenters that may be absorbed into the building industry, still building craftsmen, that is, masons, bricklayers, plasterers, tile-layers, glaziers, painters, roofers and sheet metal workers have not been trained in the past years in the numbers required if the post-war building programme is to be developed solely on conventional lines. These trades account for 24.4 per cent. of normal labour costs. (Firestone, page 29, Table 8).

We may be led by these considerations to conclude that the situation of the labour market, the availability of carpenters and the lack of bricklayers and so on, will encourage greatly the construction of houses in wood or derivative products.

Obstacles to Wood Construction

Against this is an obstacle in the shortage of timber created partly by an exhaustion due to war time exploitation and partly by the green, wet lumber with which the timber market is now flooded. A third obstacle must also be considered, namely, the large commitments in the exportation of timber that have been made by the Canadian Government to the British Government and which become effective upon the conclusion of the war. This lack of skilled labour in the building trades and the drain on timber supplies will compel the building industry to re-orientate itself towards the production techniques allowed by the materials available. It seems that the possibility of replacing conventional materials will encourage the dominating use of plywood and fibreboards and minimize the use of structural timber.

Importance of Factory Techniques to Reduce Man-Hours in Building

The labour question is a tremendous factor in prefabrication. It is one of the big reasons for the push in that direction so noticeable in Britain with its severe labour shortage in the building trades. As noted above, an average of 2,300 man-hours of on-site labour is needed to build an ordinary dwelling. Experience shows that only about 1,000 man-hours will be needed to build and assemble a factory-made house if the production is on any kind of a reasonable scale.

It is only fair to state that no accurate estimates of cost savings due to the economic use of labour have been made in the United States or Canada; this factor being so entirely dependent on the efficiency of the individual factory organization.

Evident Savings Accomplished by Factory Methods

The most evident savings have been those achieved by—

(1) Mass purchasing—the builder's volume controlling the prices paid for materials.

(2) Reduced erection time and particularly, total speed of production.

(3) Reduction of losses in materials and waste of time due to weather conditions.

C. PREFABRICATED HOUSE
(a) PRODUCTION IN ENGLAND

Post-War Housing Requirements

The British building industry has been tremendously stimulated by the announced government policy of building some 4,000,000 houses within 12 years after the construction of houses is generally resumed. The immediate need for a half million emergency houses for returning men has forced the application of mass production on the conservative British building trade. Out of this impact, created by emergency, has come the urge towards new construction methods that is such a driving force on the British market today.

British prefabrication systems are characterized by two features—

(a) They are almost invariably "panel" systems—that is, a structural frame with panel infilling.

(b) They use diverse materials—concrete, metal, composites rather than wood, because of Britain's lack of lumber.

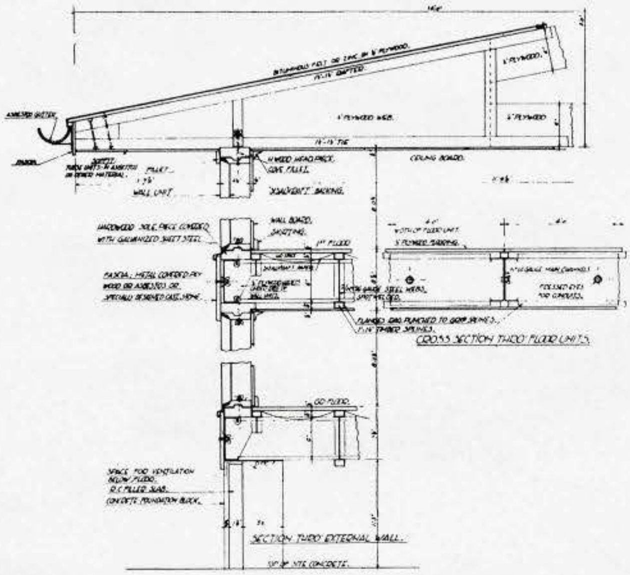

ASBESTOS GUTTER
BITUMINOUS FELT OR ZINC ON ½" PLYWOOD.
½" PLYWOOD
½" PLYWOOD WEB.
½" PLYWOOD
CEILING BOARD.
WALL UNIT
WALL BOARD.
SKIRTING.
1st FLOOR
HARDWOOD SOLE PIECE COVERED WITH GALVANIZED SHEET STEEL
FASCIA: METAL COVERED PLY WOOD OR ASBESTOS OR SPECIALLY DESIGNED CAST STONE
CROSS SECTION THRO' FLOOR UNITS.
GD FLOOR.
SPACE FOR VENTILATION BELOW FLOOR.
R.C FILLED SLAB.
CONCRETE FOUNDATION BLOCK.
SECTION THRO' EXTERNAL WALL.

Fig. 1—Tarran System of Construction — Structural details for two-storey house.

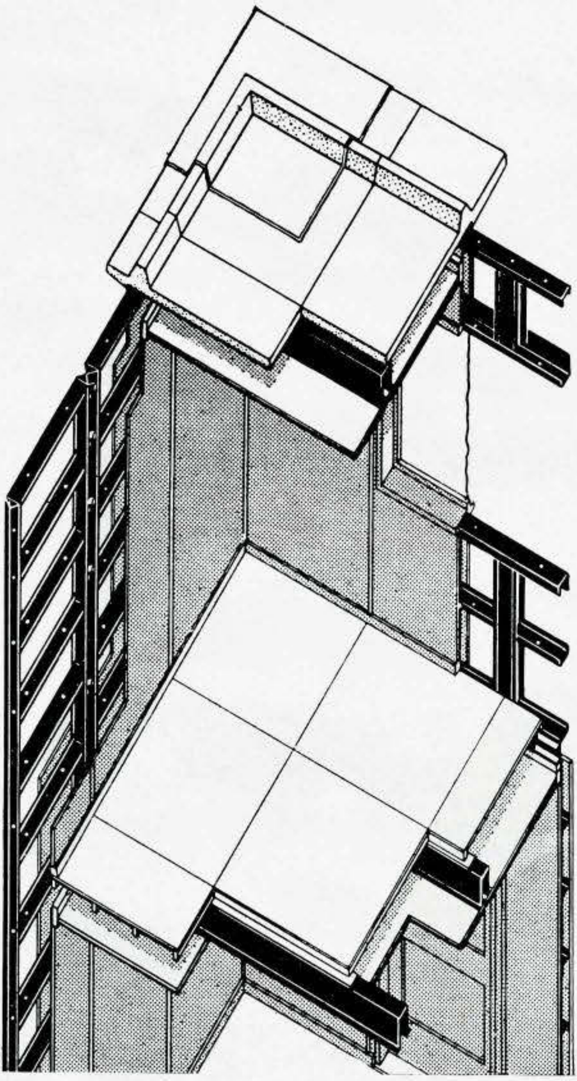


Fig. 2—Axonometric Drawing showing the Braithwaite Unit Construction System — The system employs a grid dimension of 3′-2″.

Some of the typical systems are:

THE PORTAL HOUSE or "Churchill Villa"—an all-steel house designed by the British Ministry of Works. From the single steel unit holding the bathroom and kitchen equipment to the steel wall panels with built-in steel windows, every part of the house can be built in one factory and, with only minor exceptions, from one material. The house is totally a government project. It will be leased to tenants by local authorities; its life will be limited to 10 years by government license. A living room, two bedrooms, kitchen and bathroom are packed into 616 square feet. Sheet steel wall panels are backed by heat reflecting aluminum foil and lined on the inside with steel or plywood; joints are mastic sealed. Wood flooring is screwed directly to the steel joists of the floor. Pressed metal joists of the slightly pitched roof correspond to widths of wall panels.

Operations at the job site reduce to five simple steps: A concrete slab is laid and bolted; services and drains installed; floor sections are laid and bolted; central storage wall and bathroom-kitchen unit are placed in position; walls are bolted and erected; the roof is placed. Five tons of pressed steel go into this house which is scheduled to be produced for 2,219 dollars.

THE TARRAN HOUSE developed by Robert G. Tarran, Hull, England, aims at an entirely different object than does the steel government house. The system plans for a structure with a hundred years' durability. The entire process of building a Tarran house, including foundations, can be carried out in seven days—one day for drains, one for foundations, one for erection, two for interior finishing, and one for painting and decorating. A demonstration house contains three bedrooms, a living room, kitchen, bathroom and laundry. (Fig. 1.)

Foundations are comprised of a simple levelled concrete raft 4″ thick on properly prepared ground with pier blocks and filler panels. Floors are of steel channel frames with joists of pressed steel or laminated timber; size of units approximately 12′ x 4′. Flooring can be of laminated resin bonded timber on hard fibre board. Ceilings are formed with plasterboard, plywood or other suitable lining as required. Walls are composed of units 1′-4″ wide by storey height (normally 8′) having a reinforced cast stone or concrete panel in laminated resin bonded timber frames. The external finish to the units is waterproofed and may be of any colour and have the finish of granite chippings. The joints to the wall units are made with an asphaltic asbestos-wool jointing material similar to the caulking of a ship's deck. This is fixed to the Units in the factory and sealed by an electrically heated caulking tool when walling is complete. Roof can be flat, partly pitched and flat, or pitched to about 12 degrees. The roof units are in sizes up to 4′ x 16′. They are covered with bituminous roofing felt. Boarding to receive roofing finish is of 8 mm. resin bonded laminated timber. Internal wall units are of resin bonded laminated timber covered with plywood or plasterboards.

All cupboards and fittings are prebuilt and are delivered to the site in the same manner as wall panels.

THE BRAITHWAITE SYSTEM is a unit construction system which can build up from a one-floor cottage to a three-storey flat structure. As the Tarran House this system is designed for permanent use. It employs a grid system the basis of dimension of which is 3′-2″. All parts in the house are related to this grid and are standardized accordingly—frames, beams, roof slabs, external cladding, etc. These standardized parts are applicable to all plans adhering to the grid. (Fig. 2 and Fig. 3.)

The foundations are composed of continuous concrete walls about one foot in width. "In situ" concrete is placed in forms standardized to suit both level and sloping sites. Oversite concrete 3″ thick covers the area within the outer walls. Stanchion holes 9″ deep are left in the walls to receive the legs of the frames which are later grouted in. The ground floor is suspended on steel beams in the same way as the first floor, and is so placed that the cavity beneath it can be effectively ventilated. Steel frames extend continuously to the full height of the house. These frames provide for suitable window and door openings and are of two widths 3′-2″ and 6′-4″ and are spot welded cold rolled steel. Beams are inverted U's designed to carry specified load at a spacing of 3′-2″ on a maximum span of 12′-8″. Erection is accomplished with welded-in nuts so that the erector needs to handle only a bolt. Roof slabs are of light-weight cellular concrete in standard grid sizes, 2½″ thick, reinforced with steel mesh and finished with bituminous roofing material. Outside slabs overhang the walls and are anchored against uplift by bolting to the steel beams. Windows in either steel or timber can be fixed into the standard openings. Fibreboard and cellular plywood are provided for ceilings. All boards are ½″ thick, 3′-1½″ in width and in lengths covering the full width of rooms—they attach to the steel beams by either timber cover strips or a standard metal cover strip. Insulating plywoods, fibreboard and glazed asbestos cement are used for internal lining—the sheets extending from floor to ceiling. Picture rail and skirting are timber. Three possible materials are used for exterior cladding: asbestos cement, brick and enamelled sheet steel. Asbestos cement and enamelled steel sheets are formed with vertical fluting on the exterior face. Brickwork, 4½″ thick is built close to the outer face of the steel frames with waterproof building paper between. The cladding sheets are attached to the steel frames by patented spring clips in zinc, extending the full length of the sheet. Two sheets are placed with a ½″ gap between them. The spring clip is pressed into the gap. The legs of the clip open up under the impact of a mallet to engage the legs of the frame cleats. Insulation is slag wool, rockwool, or aluminum foil except where insulated plywood is used as an interior covering.

FOAMED SLAG system developed in Glasgow, Scotland, uses waste material, a by-product of local steel and iron works, mixed with cement and forms this material into slabs for a prefabricated structure. For external use the slabs are roughcast, 6″ thick and have recesses for tieing. They are moulded mainly into three forms, window panel, with a wide blank for window fitments, solid panel, and right angle (corner section). Internal walls are 4″ thick. The biggest units yet used are 10′ wide and 8′-8″ high. The assembly system requires roads, sewers, etc., to be laid in the normal way. A concrete underbuilding carries the ground floor of standardized commercial type hollow, reinforced concrete beams. A crane site is next selected from which slabs can be deposited accurately and easily to any point over the ground floor base, the units being interlocked by recessed spaces and dog ties. First floor and roof are also of precast concrete. External walls can be given any desirable finish. Internal walls are plastered direct.

Seco System

Another well-known British system is the SECO method. The structural framework is of plywood beams, girders and columns of hollow box sections. The panels covering the structure are aero-concrete slabs encased in wood frames. (Fig. 4 and Fig. 5.)

C. (b) AMERICAN PREFABRICATION

Post-War Housing Needs

The current potential market for the low cost house in the United States may be conservatively estimated at 3,000,000 units which at the present rate of production (245,000 in 1938) would occupy the building industry for 12 years. American prefabrication has developed under this challenge in two directions:

(a) as a panel system

(b) as a sectional system

The dominating materials are wood and steel.

Panel Systems

(a) American Panel Systems:

A very typical and normal type of American prefabrication

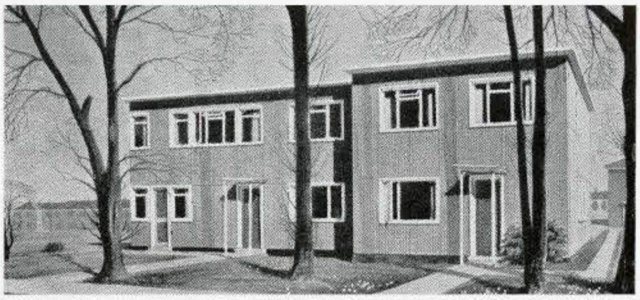


Fig. 3—Braithwaite Prototype Houses at Hendon—No. 1 house has a total floor area of 960 sq. ft., and No. 2 of 800 sq. ft.

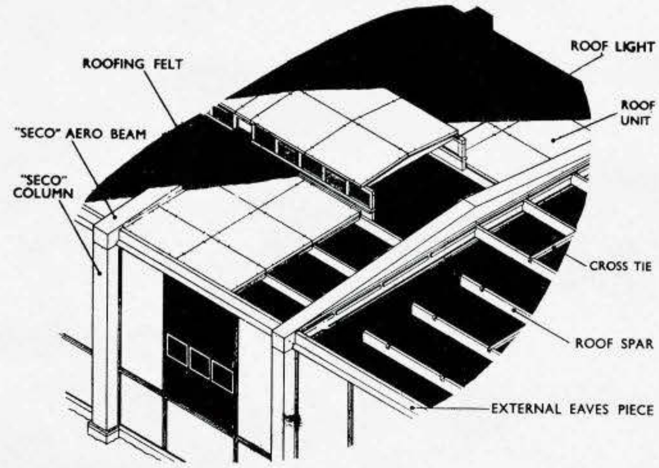


Fig. 4—Uni-Seco Structures—Typical roof construction.

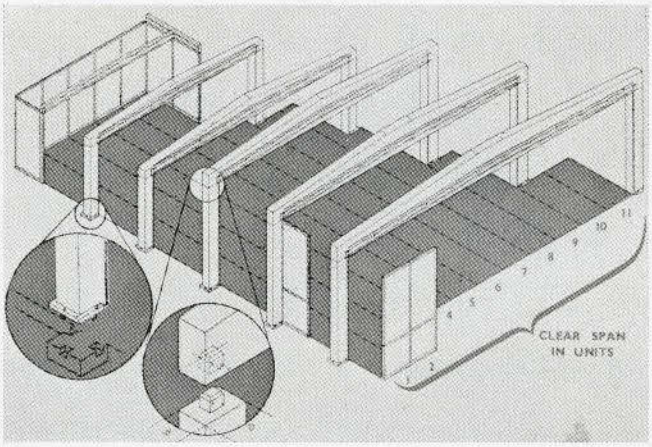


Fig. 5—Uni-Seco Structures—"Aero" Beams and Columns—scientifically designed hollow units built up from plywood in order to achieve strength coupled with lightness and economy in materials.

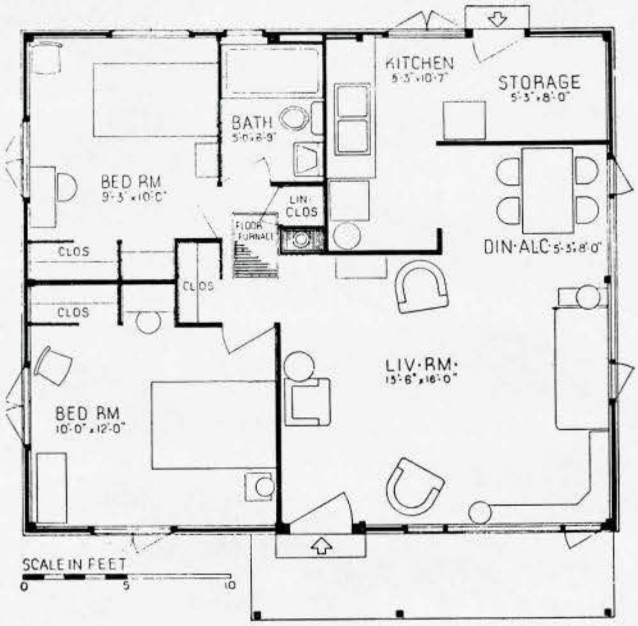


Fig. 6—Plan of "Cemesto" House developed by the John B. Pierce Foundation and built by the Celotex Corp. for the Glen Martin war housing project.

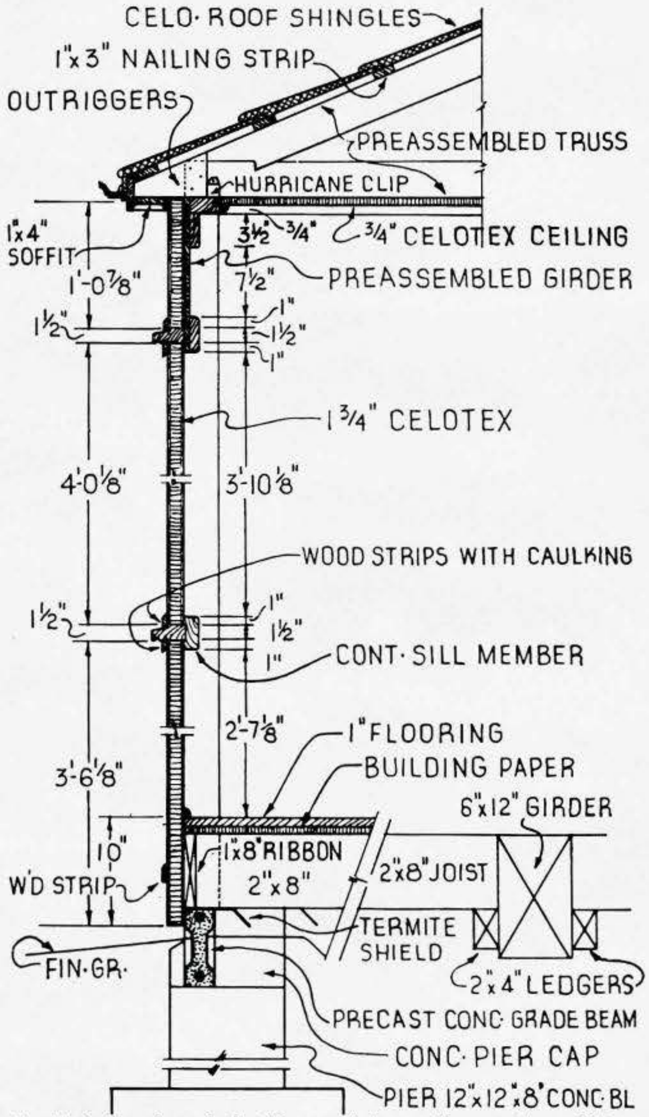


Fig. 7—Section through the "Cemesto" House—The exterior wall is a club sandwich with filling of insulating board between protecting layers of asbestos cement, weighs 4.9 lbs. per sq. ft., and is 1¾" thick—concrete footings 2'-0" x 2'-0" x 1'-0".

is the wood panel construction—a method developed largely as a result of the development of sheet materials—plywood, fibreboard, plaster and gypsum board and other wall finishes in thin sheets of large sizes. Most of the early systems were based on the use of the 4' x 8' wall and fibreboards available at the time. Today the majority of these systems employ larger panels.

THE HOMASOTE CO. of Trenton, N.J., was one of the first sheet material manufacturers to realize the possibilities in prefabrication as an outlet for its product. In 1936 the Homasote Company developed a system of prefabrication through wall, floor and roof panels assembled on jig tables in local lumber yards and using Homasote's extra large 8' x 14' sheets to create jointless room-sized panels. On the basis of a rather similar plan the DOUGLAS FIR PLYWOOD ASSOCIATION in 1939 projected a system for use in local lumber yards in which room-sized sections were preassembled with plywood as an interior finish and exterior sheathing materials. Conventional 2" x 4" framing was used and interior finish was glued in place. Doors and windows were framed into the wall section in the shop. Ceilings were assembled in room-size panels with a light 1" x 2" frame and connections were formed with ¼" plywood splines slipped into slots in the framing members. Precut joists and rafters were used and shingles or clapboard siding was applied at the site. Companies applying this system worked out scarfed connections to join the 4' x 8' plywood sheets into larger panels and special covering of cotton duck was used sometimes to cover the joints and grain of the wood and thus provide a proper surface for painting. Floors were frequently finished with hardwood flooring over the plywood sub flooring.

This type of construction employed what is sometimes called "conventional" prefabrication. The basic structure of the typical wood frame house remains unchanged. Structurally the finished house is practically indistinguishable from the ordinary frame house.

Stressed Skin Construction

An advance in panel construction was made by the application of the "Stressed skin" principle of aircraft construction to prefabrication of house panels. With the development of large size sheet materials, which constitute two-way membranes of enormous tensional strength, and with the improved method of attaching such materials practicable under shop conditions, it became possible for the first time to consider the entire cross section of wall or floor, including all the materials used for whatever purpose, as a single integrated structural unit—usually that most efficient of structural forms—the hollow box. One of the first examples of this fact was demonstrated by the U.S. FOREST PRODUCTS LABORATORY in an experimental house built in 1935. It was a one-storey structure with walls 2" thick. It used 4' x 8' stressed skin panel units made up of two sheets of ¼" plywood glued to 1⅜" x ¾" ribs. Floor and roof panels, spanning 12' had 2" x 6" ribs on 22" centres with top skin of ⅜" plywood and bottom skin ⅜" thickness. These experiments of the F.P.L. demonstrated conclusively that the quantity of material used in the conventional frame house could be reduced by more than one-half and at the same time the completed structure made considerably stronger than necessary through a combination of factory assembly of panel units.

Horizontal Panel Construction

Another approach to the problem was developed by the John Pierce Foundation in 1941 for the CELOTEX CORPORATION: and has been used extensively for war housing. (Fig. 6 and Fig. 7.) This system employs the horizontal panel. Sheets of laminated asbestos cement surfaced insulating board (Cemesto board) 1¾" thick are assembled into panels extending horizontally over 12-foot spans between 4" x 4" posts and are used as fillers between window units. Floors were carried on 2″ x 8″, I-shaped precast concrete beams; running from pier to pier to form the foundation. To carry the pitched roof the top horizontal panel of insulating board was backed up with ⅝″ plywood to form a girder. Preassembled wood trusses from 2″ x 4″ were used to span the entire width of the house and eliminate the need for interior bearing partitions. The roof itself consisted of giant shingles formed from insulation board pre-covered with mineral surfaced roofing nailed to shingle lath.

MULTIPURPOSE PANEL SYSTEM

One of the most recently developed systems of prefabricated construction is that of the GENERAL PANEL CORPORATION, New York, employing a panel unit that is neither vertical nor horizontal but may be used in either position. This system employs six standard panels—wall, door, window, floor, ceiling and roof units—all constructed on substantially the same standard frame. Two, three or four of these panels can be connected around a common axis without upsetting the spacing of the system's vertical-horizontal design module. All panels are connected to each other by means of rather complex "wedge connectors" by hammering. The system uses a 3′-4″ module. Columns, girders, joists and staircases have been developed to meet the normal standard connection of panels. The panels have a thickness of about 3″ and are faced externally with vertical boarding.

(b) THE SECTIONAL OR MOBILE SYSTEM

A basically different type of prefabrication which has developed in an important manner in the United States is that used in the so-called mobile house. Such houses are built in completely assembled sections and transported by truck or trailer to the site where two, three or four units or sections may be joined together to form a finished house. Such houses must be strong enough to meet the special conditions imposed in transit and at the same time must be as light as possible to facilitate movement.

T.V.A. HOUSES

An excellent example of this is the two-piece mobile unit developed by the T.V.A. war workers' housing. In shipment each of the halves of this house is a separate structure, open on one side and carried on a small four-wheeled trailer. The floor must not only carry the entire weight of the structure but is placed on its wood post girder foundations in such a way that the walls overhang the foundations by several feet. Most of the vertical support for the roof on the open sides of the unit is provided by small plywood cupboards strategically located and formed from plywood sheets glued at the corners to create, in effect, channel-shaped columns. Virtually all the finish material is resin bonded plywood and contributes strength and stiffness to the structure besides the functions of sheathing and finishing. (Fig. 8, Fig. 9 and Fig. 10.)

Another sectional house is that developed by the PALACE CORPORATION, a metal trailer type section containing all-service equipment, is transported to the site. Extra floors, ceilings and walls are folded against a core of this expansible house which when unfolded becomes a 24′ x 26′, five-roomed house.

The most interesting feature of the American prefabricated picture is the entry of big industrial corporations into the field. The two billion dollar UNITED STATES STEEL CORPORATION, the biggest steel producer in the world, recently purchased a substantial interest in the GUNNISON HOUSING CORPORATION of New Albany, one of the leading prefabricated companies. Gunnison at present produces a comparatively simple panel system on the stressed skin principle. Exteriors are sheathed with clapboard or shingles on the site. But this firm experimented with metal construction as early as 1932.

Also, GOODYEAR TIRE AND RUBBER COMPANY has stepped

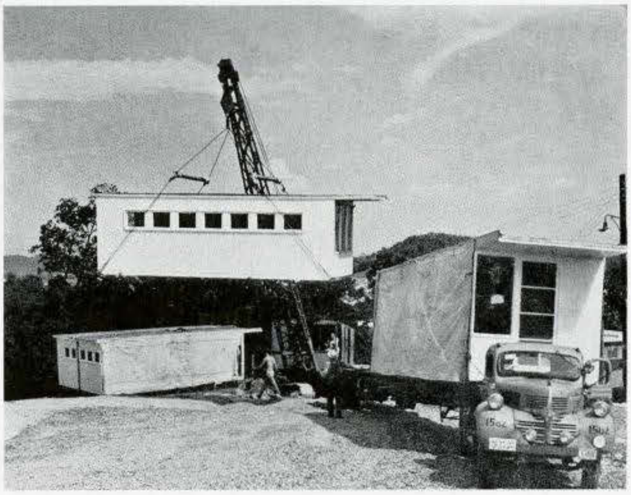


Fig. 8—T.V.A. Sectional Type Plywood House—A crane lifts a house section off a truck preparatory to placing it on the foundation at left. After unloaded adjacent to the two sections previously placed, a trained assembly crew will take over and make the house ready for occupancy in a few hours.

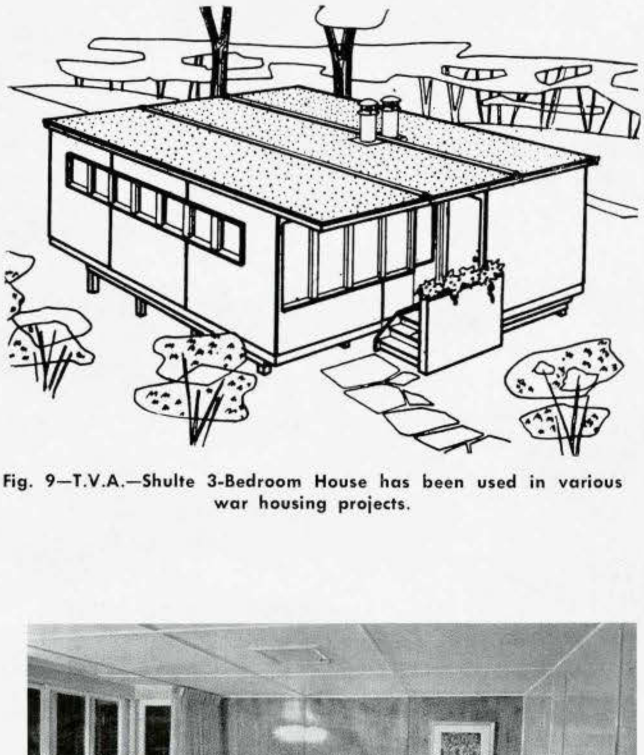


Fig. 9—T.V.A.—Shulte 3-Bedroom House has been used in various war housing projects.

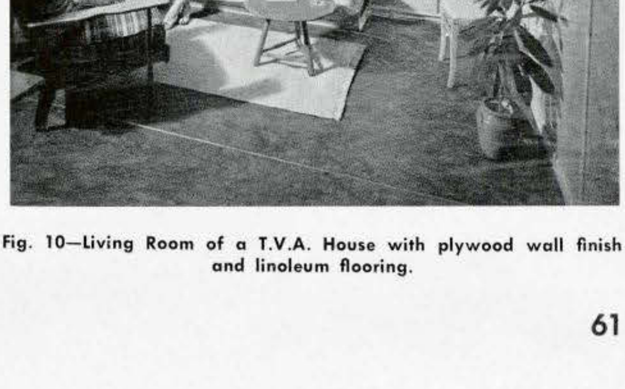


Fig. 10—Living Room of a T.V.A. House with plywood wall finish and linoleum flooring.

actively into the field by creating a subsidiary organization to manufacture low cost houses to sell around $2,000.

C. (c) COMPARISON OF ENGLISH AND AMERICAN PREFABRICATED SYSTEMS

English Systems as Permanent Structures

It is very apparent in comparing the development of methods of factory house building in Britain and the United States that the pressure of the English situation has resulted in a very different attitude towards the problem. The most important fact is the insistence on the permanent character of their structures of English manufacturers. This is not true, however, of the government agencies which are concerned only with the emergency housing problem. An advanced attitude is expressed by the Braithwaite Company, for example. They consider their system as simply an extension of accepted building practice—an advance in the technique of building. In this connection they say:

"For years it has been accepted practice to prefabricate sections of steel frames when erecting large industrial buildings, office blocks or blocks of flats. But in so far as ordinary house construction is concerned, the process stopped short at such components as door-frames, stairways and window frames. The Braithwaite system aims at extending the process to its logical conclusion, utilizing to the maximum modern methods of production but bearing in mind the need for variety and individual expression in the home. We avoid the word 'prefabrication' in describing the method because it has come to suggest something temporary or make-shift. We would strongly emphasize at the outset that Braithwaite houses are as permanent as normal brick or stone houses."

American Demountable Non-Permanent Structures

It can be readily seen that this application is very distant from the approach, for instance, of the T.V.A. which had initially as its problem, the provision of shelter for construction workers on dam and other public works projects. The object was the setting up of little communities that could be easily disbanded. The system of light sectional structures transportable by truck, requiring minimum assembly and reducing all jointing and finishing work to smallest scale, was obviously admirably suited to the specifications. In the war-time housing which saw the greatest impetus given to prefabrication in the United States, again the problem was restricted to something of an admittedly temporary nature, which could satisfy the all-important factor of speed. In this atmosphere prefabrication in the United States developed and is developing.

The realization that prefabrication can be simply an extension of the process of producing building materials in the factory has not yet, in general, touched the American market.

In following this argument it is at once obvious why the British methods have developed as panel systems. The process of producing permanent building parts cannot conceivably jump immediately from units the size of bricks, concrete blocks, hollow tile and so on to units the size of whole house sections or units of room-sized walls. Hence, the perfection of the panel of rather limited size for wall, roof or floor.

C. (d) THE CANADIAN PREFABRICATION SYSTEMS

The Canadian prefabrication systems have developed under the same conditions as the American systems. Always initially as temporary structures, suitable for summer camps and emergency wartime housing. The firms actively engaged in the business are:

THE HOMASOTE COMPANY (Canada) Ltd., at Lachute, Quebec, is producing cottage type dwelling. They are sold through the Montreal department store, Henry Morgan and Company, f.o.b. the factory at Lachute where they are made by local labour. They are designed especially for the Laurentian sporting trade—as summer cottages and ski cabins. Homasote provides a shell of a house. Painting, plumbing, erection, transportation and lighting is extra. The following prices are quoted under the above conditions: 1,450 dollars for the largest, 10′, 0″ x 13′, 9″ living room, two bedrooms, kitchen and bathroom; 1,150 dollars for living room, bedroom, kitchen; 850 dollars for living room, two bedrooms; 650 dollars for living room, kitchen and bathroom.

The construction system is identical with its American counterpart utilizing large (8′ x 14′) sheets of Homasote board on wood frame.

PREFABRICATED BUILDINGS LTD., Vancouver, B.C., manufacture according to the LOXTAVE patented system, summer camps and bungalows which they have converted to wartime housing uses. The system is developed in solid timber construction by means of wood joints, formed by special saw cuts on T. and G. principle.

CANADIAN WOODEN AIRCRAFT, Toronto, Ont., are preparing to build an experimental house in 1945 which is an adaptation of the T.V.A. truckable house—in Douglas Fir plywood, on the stressed skin principle with minimum dimensioned studding.

COCKSHUTT factory is building an experimental house in plywood and timber. Floor panels are developed on the cellular principle.

HALLIDAY HOUSE, Burlington, Ontario, produce sectional houses in solid timber. They are developed in two sections, one larger than the other—the smaller containing service elements, the larger the living areas. They are erected on flat cars for delivery to site.

Conclusion—Probable System for Canadian Market

The Canadian and, indeed, the American market, is very much in the running for a system of prefabrication which aims at a permanent structure but developed in wood or derivative products, as a prototype of the more advanced British systems but without their insistence on steel and concrete products.

An interesting note on the Canadian situation is the announcement by the Soldiers' Settlement Board, which proposes to build 50,000 houses under the Veterans' Land Act. The following statement is made (Financial Post, December 2nd, 1944).

"The principle of prefabricated panels has not been discarded, but we prefer to use the result of further experimentation and development along lines adapted to the variations in Canadian climate."

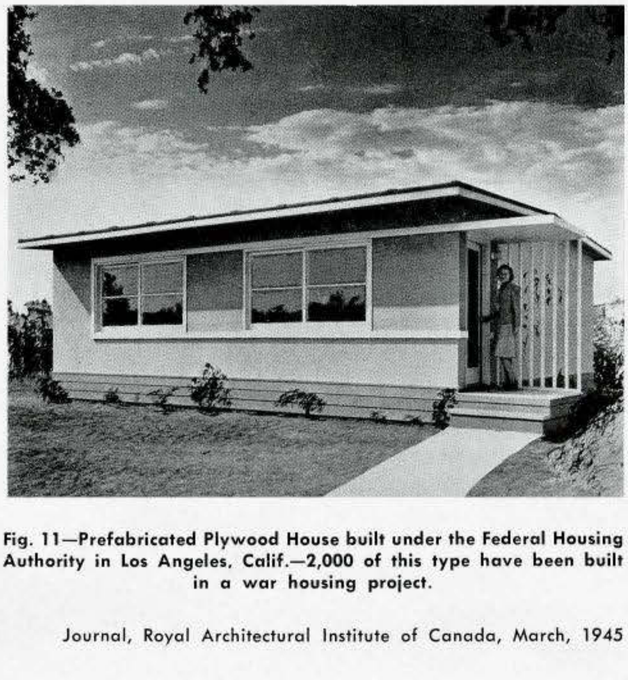


Fig. 11—Prefabricated Plywood House built under the Federal Housing Authority in Los Angeles, Calif.—2,000 of this type have been built in a war housing project.

THE PROVINCIAL PAGE

ALBERTA

President's Address

On this, the Thirty-eighth Anniversary of Incorporation, it is again my very great privilege and pleasure to greet you and to extend to you a warm welcome to our Thirty-fourth Annual Meeting. To those of our new members who are attending an Annual Meeting for the first time, I extend a special welcome. I can assure you that we want you to feel at home amongst us, and I invite you to take part of our deliberations. You are now a part of this Association, and therefore it is your privilege to share in the discussion of any matter that may be under consideration. I trust that you will not hesitate to exercise your right. For the sixth consecutive year we meet under the horrible conditions imposed upon us by this ghastly war, yet we can be thankful that our Country has thus far been spared all the cruelties and horrors that are attendant upon bombing and the horrible destruction and waste through invasion.

It is with feelings of deep gratitude that I appear before you on this, my sixth year as your President, as the affairs of your Association have been such as to require the utmost perspicuity during the year just past. Many peculiar problems have had to be met, but with the co-operation of your Council each one has been settled, or is in the process of being settled in accordance with our Regulations.

Necrology

During the year the grim reaper took away from us one of our oldest and most highly respected members in the person of George Fordyce, who has gone to that "undiscovered country from whose bourne no traveller returns." Our hearts go out in sympathy to the bereaved ones that are left behind to mourn the loss. I now ask you to rise and pay a silent tribute to departed merit.

> "Peace and rest at length have come,
> All the day's long toil is past,
> And each heart is whispering, Home,
> Home at last."

Visit of President R.A.I.C.

In October last we had the pleasure of welcoming in our midst Mr. Forsey Page, President of the R.A.I.C., and I feel that I am voicing the sentiments of our whole membership when I say that we were more than glad to have him in our midst, so that he might have an opportunity of becoming better acquainted with each and every one; also that we might be permitted to hear his message. I am certain that this visit will have a far-reaching effect on the whole profession at large, and this Association in particular.

Council Meetings

Eight regular meetings and two special meetings, or a total of ten meetings of your Council have been held during the year. Copies of the minutes of these meetings have been sent to each member, from which it could be seen that many matters of the utmost importance to the profession have been discussed. It would, therefore, be superfluous here for me to enlarge on these items as nothing can be gained by mere repetition. The moral, however, to be drawn from a persual of these minutes, appears to me to be a lack of unity within our ranks. May I be pardoned if I endeavour briefly to develop this subject which might be considered in the same category as the cardinal virtues of our profession. As a fitting illustration for the topic I am reminded of the Medallion that was designed for the "British Empire Exhibition, 1924." As you look at the Medallion you see at the left Britannia sitting on a chair placed on a dais; in her left hand in place of the usual trident, she holds out the small figure of a female holding out in its left hand a laurel wreath. Facing Britannia, five female figures, symbolic of various parts of the Empire are seen—Africa holding the Lion; Canada the Beaver; India the Elephant; Australia the Kangaroo and New Zealand the Lamb; the whole representing the British Commonwealth of Nations. On the reverse side of the Medallion is found the following motto: "Make all sure we are one." Briefly the theme is Unity.

The certainty that we are *one* ensures Unity, Unanimity and Concord. Unity is vital, unity is very necessary. Unity is highly important. Unity is absolutely essential to the best interest of each individual as well as our Association as a whole. Wherever it is in evidence; wherever it obtains and wherever it is uppermost in the minds of individuals, the results are far-reaching in every line of endeavour. I think we must agree that Unity or Oneness is inseparable from all the traditions of our profession, that it is an essential part of all the ethics of the profession, for without that union of purpose which it signifies we shall be unable to attain the high purposes of our calling, and so disunion steps in.

Let us examine this phase of the subject for a moment. If we allow disunion to creep in we shall find ourselves hopelessly separated from the high ideals and traditions of the Profession. Disunion would disintegrate all the essential parts of those things we value most in the practice of our calling, and it would be impossible to attain the best in all those things that are associated with our profession.

With disunion we shall be so hopelessly disunited as to destroy the continuity, the unity or the union of all that we cherish. In other words there would be no traditions or landmarks if you will, left for us, and we would then be divorced from everything that we value most in our profession.

And so, ladies and gentlemen, "United we stand—divided we fall." None would doubt the wisdom of this statement. Let us then, in the words of the motto on the medallion I have referred to, "Make all sure we are One." For, in the words of Edwin Markham:

> "The crest and crowning of all good,
> Life's final star, is Brotherhood."

I cannot close without some slight reference to those who have so kindly assisted me during the past year. To the various members of the Council, who gave of their time unstintingly, I express my appreciation for their kindly co-operation and assistance, and for their painstaking attention to the various matters that came before us. In particular I wish to pay a tribute of thanks to our Secretary for his untiring efforts and the patient manner he exhibited in looking after the various affairs of the Association, as well as his kindly assistance in every circumstance.

Conclusion

In the foregoing remarks I have endeavoured to present to you the facts of the year's working as I see them. During this year I have endeavoured to serve to the best of my ability. However, such service will not be very efficacious if it stops at the officers elected to serve for the year, no matter how well they may have carried out their duties. The welfare of the Association, and all that it stands for, must appeal to and be adopted by every one of its members, for then and then only can we present a united front to overcome all our difficulties as they may arise. And so I close with the words of Theodore C. Williams:

"Life is a voyage. The winds of life come strong
From every point; yet each will speed the course along,
If thou with steady hand when tempests blow
Canst keep thy course aright and never once let go."

J. Martland, Pres.

MANITOBA

At the Annual Meeting held at the Fort Garry Hotel, Winnipeg in January last, Mr. George G. Teeter was elected President, and Mr. Lawrence J. Green, Vice-President. Following are the other members of the 1945 Council: Neil K. Brown, C. W. U. Chivers, Wm. Fingland, R. E. Moore, E. Fitz Munn, M. S. Osborne and G. Parfitt.

A welcome was given to Mrs. H. M. Lord, being the first lady to become an Architect in Manitoba.

An interesting report was given by Professor Osborne in connection with the Department of Architecture and Fine Arts at the University of Manitoba. He reported a very satisfactory condition as regards enrolment, being eighty-two altogether: 50 in Architecture and 32 in Interior Decoration. Sixteen years ago, there were about thirty. He was pleased to report that the R.A.I.C. medal had been won this year by Ernest Smith. The Association voted to continue the Scholarship to the Student receiving the highest aggregate of marks in the third year. Also that an additional scholarship be granted to the Student in the second year with the highest aggregate marks.

It was decided to raise the Annual dues of the Association from $15.00 to $25.00, to cover additional expenses that may be incurred during the year.

The matter of Contractors preparing their own plans was fully discussed, and the Council were instructed to find out if it would be possible to change our Act to limit such practices. This brought up the matter of advertising as a means of educating the public to the value of Architect's services, and a committee was appointed to study this question and to report on a scheme of Provincial advertising.

A resolution was also passed to take up the matter with the Institute to determine if advertising throughout the Dominion would be possible.

The President regretted the passing of Percy Over and John Woodman, two members who had been actively connected with the early history of the Association, both their names being mentioned in the inaugural meeting of the Association on May 15, 1906.

Following the Annual Meeting, a dinner was held at which thirty-six sat down. The guests were Dean E. P. Fetherstonhaugh, of the University of Manitoba; Mr. J. F. Hyde, Surveyors Association; Mr. Rivington, Professional Engineers; Mr. H. M. White, Winnipeg Builder's Exchange. Also students of The Architectural Department of The University of Manitoba.

E. Fitz Munn.

ONTARIO

Apparently one of the privileges of a Provincial President of Architects' Association is to carry the ball when there is no one else left to throw it to, so I find myself left responsible for this month's letter, and with very little time left before publication.

As most of my time this year so far has been taken up preparing for, and presiding at the Annual Meeting of the O.A.A., held in Toronto on the 27th of January, it seems to me that it will be good policy for me to outline some of the outstanding features of that meeting.

The difficulties of making suitable arrangements elsewhere led us to the decision to hold all our meetings and functions at the King Edward Hotel. This proved to be a very happy choice; our members had a much better opportunity to fraternize, and everybody seemed to take full advantage of the opportunity, and a splendid feeling of friendliness prevailed throughout the whole day.

One of the big results of the Business session in the morning was the unanimous decision of the Association to support the R.A.I.C. in any move for expansion of their usefulness, by establishing a Head Office in Ottawa, and a regular full time National Secretary or Manager, and to raise the fees when necessary, to accomplish this desirable forward movement.

Another step forward was made in the adoption of the Housing and Town Planning Committee's splendid report, which included recommendations that will be far reaching if, as, and when, they are fully carried out.

This Committee have done a very complete and extensive work and are planning further advances and improvements that will meet with the wholehearted approval of the Profession generally.

The members of our Joint Committee of the O.A.A. and the Professional Engineers of Ontario, reported progress and very good co-operation between the two bodies. Since the Annual Meeting there have been other satisfactory conferences of this Joint Committee, which promise further definite improvement in our relations.

A new departure was reported in a conference between representatives of our Association, and the General Contractors' Association; many items of mutual interest were discussed, and we can expect good results for all parties to ensue from these meetings. We made a particularly happy choice of speakers for the Annual Meeting. At luncheon, Mr. J. Lance Rumble gave a humorous address on Post War Planning. This was real relaxation after the morning session, and surely convinced everyone present that there was a lot of time, talent and money wasted in futile discussion of this subject.

A pleasing and instructive feature of the afternoon was the presentation of a paper on "War Time Construction Activities in the U.S.S.R." This was prepared by Mr. P. P. Novojilov, New York Representative of the Soviet Government Purchasing Commission. In his absence, which was due to illness, the paper was read by Miss Seamens. A Russian lady Architect, Mrs. Altzov, was also present and after the paper was read, answered questions relating to conditions in her country.

Professor R. F. Legget gave us a very interesting and informative address — "The future of Architect-Engineer Relations."

At the Annual Dinner, held in the evening, Professor K. Grant Crawford, of Queen's University, spoke on "Housing and Municipal Government."

Both these addresses were timely and worth while, and we have hopes of them being published in "The Journal."

Presentation of the Medal Winners from the University of Toronto, and Certificates to the newly elected Members of the O.A.A. was also a pleasant feature of the Dinner.

Mr. J. P. Hynes was inducted in the Office of Secretary Emeritus of the Association, and presented with a Silver Salver, suitably engraved for the occasion. The presentation was made by Gordon A. West, F.R.A.I.C.

Mr. Merrill Cameron, Chairman of the Ottawa Chapter, contributed several delightful Tenor Solos, accompanied by Gladstone Evans at the piano.

Judging by comments, everyone present seems to have enjoyed a pleasant and profitable day.

W. J. Abra.